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TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 120
DECEMBER, 1921

TRANSACTIONS OF THE FIRST ANNUAL CONFERENCE OF STATE SANITARY ENGINEERS

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HELD AT WASHINGTON, D. C.
MAY 25, 1920

Prepared by Direction of
THE SURGEON GENERAL

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FIRST ANNUAL CONFERENCE OF STATE SANITARY ENGINEERS.

TRANSACTIONS.

The First Annual Conference of State Sanitary Engineers was held in Washington, D. C., May 25, 1920.

The following persons were present at the conference:

Alabama.—G. H. Hazlehurst, State sanitary engineer.

Arkansas.—M. Z. Bair, State sanitary engineer.

Connecticut.—J. Frederick Jackson, State sanitary engineer.

Florida.—George W. Simons, director, bureau sanitary engineering, State board of health.

Illinois.—Harry F. Ferguson, chief sanitary engineer.

Indiana.—John C. Diggs, State sanitary engineer.

Kansas.—C. A. Haskins, director, division of water and sewage, State board of health.

Kentucky.—A. E. Gorman, State sanitary engineer.

Louisiana.—John H. O'Neill, State sanitary engineer.

Maryland.—Abel Wolman, division engineer, State department of health.

Michigan.—E. D. Rich, State sanitary engineer.

Minnesota.—H. A. Whittaker, director, division of sanitation, State board of health.

New York.—Theodore Horton, director, division of sanitary engineering, State department of health.

North Carolina.—H. E. Miller, director, bureau of engineering and inspection, State board of health.

North Dakota.—Isador W. Mendelsohn, State sanitary engineer.

Pennsylvania.—C. A. Emerson, jr., chief engineer, division of engineering, State department of health.

South Carolina.—E. L. Filby, State sanitary engineer.

Tennessee.—C. N. Harrub, State sanitary engineer.

Texas.—V. M. Ehlers, State sanitary engineer.

Virginia.—Richard Messer, State sanitary engineer.

United States Public Health Service.—Associate Sanitary Engineer Sol Pincus.

FIELD OF COOPERATION AMONG STATE SANITARY ENGINEERS.

V. M. Ehlers,
Chief Sanitary Engineer, Texas State Board of Health.

In these days of progress and accomplishment, cooperation and unity of purpose have been deciding factors to success. Captains of industry as well as the knights of labor recognize in cooperation and union the signposts that direct the way to the goal of attainment.

The proposition of cooperation among State sanitary engineers was seriously discussed, probably for the first time, during the convention of the American Public Health Association at New Orleans, in December, 1919. A number of State sanitary engineers were in attendance at this conference and several meetings of these men were held at which the general situation was discussed. A temporary organization, composed of all present at the time, was formed. Possibly the first important matter to consider is to make this temporary organization permanent. After this association has been perfected, actual work can proceed in a more systematic and orderly manner.

The field of proposed cooperation covers the entire sphere of activity of the State sanitary engineer. While it is true that some of the problems confronting us down in the South are not as pertinent in the Northern States, the fact remains, nevertheless, that mutual good could be accomplished by comparison of methods practiced and results obtained. Nearly all really important propositions have a close sectional corelationship.

The most difficult task that confronts the State sanitary engineer is, without doubt, the treatment and disposition of domestic and industrial wastes. Various methods are used to dispose of the garbage and other collected wastes. Quite a number of types of incinerators and reduction plants are in use—some of them operate more satisfactorily than do others. Models of sanitary toilets exist by the score. Some of these function less satisfactorily than do the others. The same may be said of residential sewage disposal plants.

Most States have laws regulating the purity of the effluent from sewage treatment plants and describe and direct methods for the disposal of this effluent. Analytical methods employed vary very much indeed.

The problem of determining what constitutes stream pollution is a most vexing one, in my opinion, and can be settled only after a thorough and exhaustive study of the subject in all its phases, and could best be accomplished by a committee of sanitary engineers. This question is especially important when the pollution of a stream flowing through several States is considered. It is highly essential that uniform standards clearly defining such contamination be worked

out and adopted. In this connection it would also be desirable that we use our concentrated efforts to the end that uniform State laws be promulgated covering and regulating this feature of sanitation.

Uniformity in rat-proof construction of docks, loading platforms, and guards in the various coastal States is needed.

It would also appear timely and proper to make a study of the construction and sanitation of dairies, municipally and privately owned abattoirs, ice factories, and similar industries, with a view to standardizing the sanitary features necessarily a part of plants of this character.

Purification of water is another problem probably given more general study and attention than any other in the field of sanitary engineering, and justly so, because upon the purity and wholesomeness of our water supplies depend directly the health and welfare of our citizens. The occasion for adopting stringent measures to safeguard the sources of our water supplies is urgent and universal. Many States have already adopted regulations that are very beneficial and far-reaching in the endeavor to bring about the desired result.

In recent years much serious thought has been given to the study of sanitary drinking fountains and a great many sanitary fountains have been placed upon the market.

Artificial swimming pools may be found in many communities. Some of the pools are insanitary, and instead of aiding and improving the health of the bathers may at times become a distinct menace to the patrons. Sanitation of swimming pools is a crying need. Strict regulations governing the construction and operation of these installations should be worked out and urged for adoption by the State boards of health.

One of the really serious conditions confronting the Nation at this time and one which is rapidly becoming worse is the housing problem. A combination of circumstances has brought about a situation which is well-nigh intolerable. Apparently no relief is in sight in the immediate future. Action tending toward the alleviation of conditions is imperative. Under this subject may also be considered plumbing, heating, lighting, and ventilating. Each of these are of great importance and will become more so as our population increases.

Sanitation of public buildings, such as jails, theaters, and schools, is a matter with which all State sanitary engineers have been directly concerned for some time. The authority granted the State officials for the proper control and regulation of these institutions should be amplified and more clearly defined.

Another problem directly affecting the Southern States, and in a lesser degree the North also, is mosquito control. Several of the Southern States in which malaria is prevalent have made wonderful progress toward the eradication of the mosquito. A comparison of methods pursued and results obtained would produce some valuable information for those now engaged in the work.

Other problems requiring further detailed study and thorough investigation by sanitarians are practical control measures of pellagra and hookworm.

The foregoing may be considered as a brief and rather incomplete outline of the field of activity of our State sanitary engineers. That much good could be accomplished through cooperation among these engineers there can be no doubt. The question then resolves itself into the proposition of deciding which would be the best method of procedure to obtain the desired result.

The United States Public Health Service, as we all know, has been of great value to us in lending us material aid and assistance in furthering our work in the several States. Our aims and ambitions are very closely related. It therefore occurred to the writer that the United States Public Health Service might be induced to detail a sanitary engineer who would act as whole-time secretary of this organization. It is our opinion that a capable man's time could hardly be spent to better advantage. The secretary's office would be a sort of a clearing house for reports of special committees appointed to make investigations and recommendations concerning the various problems confronting our organization. Individual members would also report on work accomplished, together with their personal suggestions and recommendations to bring about improvements. Copies of all meritorious reports could be submitted to the various members, so that every one would at all times be in touch with everyone else individually and with the association as a whole. It might also be advisable for the organization to publish an abstract journal in which articles of interest to members could be abstracted. The articles themselves could be furnished to interested members on application to the secretary.

In connection with these regular duties mentioned, the secretary might keep a list of sanitary engineers available as assistants, city sanitarians, or for similar positions, and upon application by a member, furnish him with names and qualifications of men available.

It is our opinion that if a scheme of procedure similar to the one outlined is adopted and put into effect, not only will the science of sanitary engineering be greatly benefited but valuable service will be rendered the citizens of this country.

THE INFLUENCE OF ENGINEERING WORK OF PUBLIC HEALTH DEPARTMENTS IN THE REDUCTION OF MORTALITY.

THEODORE HORTON,
Chief Engineer, New York State Department of Health.

It would be difficult indeed to measure with any degree of accuracy the influence which sanitary engineering work exerts upon the reduction of disease mortality. This is obviously due to the fact that in the field of public health there are no sharply defined lines which separate the work of the engineer from that of the chemist or the biologist or the physician. Generally speaking, these professional experts all work in more or less close cooperation, attacking the same great problem of life-saving merely from different angles or strategic points, leaving the question as to the share which each contributes individually to the whole, a somewhat ill-defined and indeterminate one.

On the other hand, the work of the engineer in this field is perhaps more sharply defined and more exclusive in character than the work of any other profession. This is particularly true with respect to certain activities, such as the supervision of public water supplies, the extermination of mosquitoes, the abatement of nuisances, and the supervision of milk pasteurization. Again, some of these activities, such as the supervision of public water supplies and the extermination of mosquitoes, are associated directly and exclusively with certain specific diseases, such as typhoid fever, cholera, malaria, and yellow fever; and it is obvious that any reduction in mortality from these diseases may, within certain limits, very properly be used as a measure of the effect and value of these lines of engineering work. Other activities, however, such as the abatement of nuisances, or the examination of sewerage plans, are only indirectly associated with disease transmission, and for this reason any measure of the effect and value of these lines of work, based upon a comparison of mortality rates, becomes difficult, if not impossible.

When, therefore, we attempt to use mortality rates to measure the effect of any particular engineering activity, considerable care must be exercised; and two points in particular should be borne in mind. One is that there may be other sources or agents of infection responsible for the particular disease whose mortality rates are being compared than those directly associated with the particular engineering activity in question. The other is that in addition to the preventive measures carried on through any particular engineering activity, there may have been other corrective measures taken, such as immunization and medical treatment.

As an illustration of both of these factors we may take the case of typhoid fever. This disease, as you all know, may be caused not

only by infected water, a strictly engineering factor, but also by infected foods, carriers, and contact infection, factors not usually associated with engineering work. Unless, therefore, vital statistics are carefully recorded, or other epidemiological evidence is available indicating the proportion of infection due to impure water supplies as compared with infection due to other factors, one may readily be misled in crediting a declining death rate from this disease to engineering activities. Or again, taking the same disease, it is possible that with effective typhoid vaccination, as practiced in military service and to a limited extent elsewhere, a low death rate from this disease may be attained largely independent of the purity of water supplies. Unless we know how extensively this immunization treatment is practiced we may again be misled in our conclusions.

Fortunately a number of our States have kept very complete statistical and epidemiological records covering a considerable period of years, and these indicate quite clearly the extent to which the typhoid fever rate has been lowered through improvements in public water supplies. The experience in New York State is particularly interesting, for in this State not only has unusual care been taken in reporting vital statistics, but for many years the engineering division, in addition to its work of supervision over public water supplies, has had charge of all epidemiological investigations with reference to this disease. The story may best be told perhaps by the accompanying chart and table, one showing the typhoid fever rate in the State from 1885 to date, and the other a list of cities of the State with the typhoid rates before and after the installation of water purification plants or other improvements.

You will note from the chart, showing the typhoid fever rate for the State, that the curve may be divided into two distinct portions or periods, one prior to the year 1907 and the other subsequent to 1907, the two portions of the curve being quite dissimilar in some respects and indicating clearly the influence or relation which engineering work has had in reducing the prevalence of this disease. The sanitary engineering division was established in 1906. Prior to this year there was no systematic supervision whatever over the water supplies of the State, and by observing the character of the curve for this earlier period you will note that the typhoid fever rate is not only very irregular, but excessive, averaging about 23.1 for 100,000, and reaching a maximum of 30 in 1891.

In contrast with this portion of the curve, note the portion subsequent to 1907, during which the engineering division has been constantly and actively engaged in work of investigation and supervision of the public water supplies of the State. You will observe that from the very beginning of this period the typhoid fever rate

has uniformly and progressively declined, with only a slight deviation from a straight line, and with almost phenomenal rapidity,

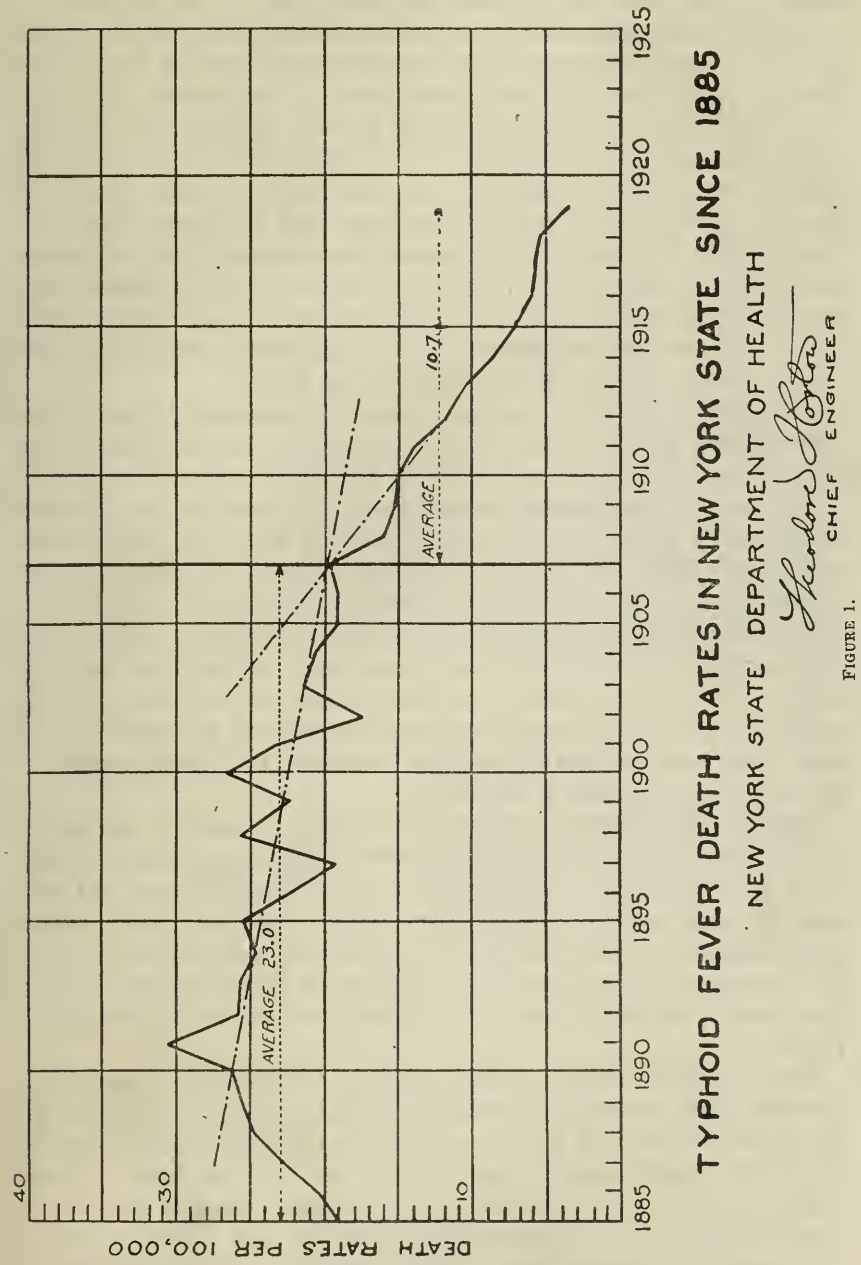

FIGURE 1.

reaching the very low rate of 3.3 per 100,000 in 1919. This rapid decrease in the typhoid fever rate subsequent to 1907, as compared

with the decrease prior to 1907, corresponds numerically to a saving of some 7,000 lives during this 12-year period, a rather striking indication of the extent and value of this particular life-saving work.

While the circumstantial evidence presented by this chart indicates that this rapid lowering of the typhoid-fever rate in New York State is due primarily to engineering work of supervision of public water supplies, this evidence is quite clearly confirmed by the evidence furnished by the table (pp. 9–13), which shows for each of the cities of the State the typhoid-fever rates before and after the introduction of water purification. You have only to glance down this list to see that in nearly every instance the rates have dropped almost immediately following the introduction of these improvements, and that by no possible coincidence could any other reason than purification or other improvements in these supplies be responsible for the sudden lowering of these typhoid-fever rates.

The influence of other possible causes of this rapid decline in the typhoid rate of the State must, of course, not be overlooked; and here statistical and epidemiological records bear out our conclusions. The use of typhoid vaccine has been resorted to to only a very limited extent in the State, and the influence of this factor has been almost negligible. Milk and other food epidemics have been few, and the typhoid rate from this cause has been insignificant in comparison with the total typhoid rate for the State. Typhoid carriers have been apprehended in a number of cases, but the total of their influence has been very small. Secondary infection has been, and will probably continue to be, an important factor, but we must bear in mind that these secondary cases are secondary to primary ones and must be logically classed with them.

Briefly, our experience in New York State, based on statistical and epidemiological records, has clearly demonstrated that typhoid fever has been, and is still, largely a water-borne disease; and that only through careful supervision of public water supplies, prompt investigations of outbreaks and the immediate application of remedial measures, while these outbreaks are in their incipient stages, has it been possible to reduce the typhoid rate to almost a negligible figure.

While typhoid fever and cholera hold first place among the diseases which are rapidly being eradicated, largely through the influence of engineering activities, there are two others which may be considered close seconds, viz, malaria and yellow fever. These diseases may both be considered largely tropical, though even as far north as New York State malaria has been, and is still, a factor, and in order to control it we have in force one of the most effective mosquito-extermination laws in the country.

City and population. (State census of 1915.)	Source of water supply.	Present treatment.	Remarks.	Typhoid fever death rates. (Average annual deaths per 100,000 population.)							
				Before improvement in water supply.		After improvement in water supply.					
				Years.	Average.	Years.	Average.	1901–1905	1906–1910	1911–1915	1916–1918
Albany (107,979)	Hudson River	Prefilters, slow sand filters, and sterilization.	Sand filters installed 1899; prefilters installed 1908; hypochlorite plant installed 1909.	1889–1899	88.8	1900–1918	18.7	21.8	17.0	18.3	10.2
Amsterdam [1] (34,319)	Hans Creek and Steele Creek with large reservoirs.	No treatment	Progressive improvement, two small polluted streams abandoned, 1910.	1898–1910	28.8	1911–1918	8.0	23.8	14.9	11.0	2.9
Auburn [1] (32,468)	Owasco Lake	Sterilization	Hypochlorite apparatus installed 1911: liquid chlorine treatment since 1913.	1898–1910	20.7	1911–1918	14.1	20.6	18.2	14.3	14.0
Batavia [1] (13,278)	Tonawanda Creek	Mechanical gravity filters and sterilization.	Filters and liquid chlorine installed 1917.	1898–1916	30.1	1917–1918	21.2	36.9	31.0	16.5	13.4
Beacon [1] (10,825)	Surface streams: auxiliary supply from Fishkill Creek.	Auxiliary supply sterilized when used.	Liquid chlorine plant installed in 1914.	1913–1914	9.0	1915–1918	4.8	.....	.....	29.2	3.1
Binghamton (53,668)	Susquehanna River	Mechanical gravity filters, sterilization.	Filters installed in 1902, hypochlorite.	1889–1902	50.3	1903–1918	11.6	22.2	13.6	12.0	8.5
Buffalo (454,630)	Lake Erie	Sterilization	Liquid chlorine plant installed 1913.	1901–1913	24.1	1914–1918	11.2	29.2	23.3	15.6	9.7
Canandaigua (7,501)	Canandaigua Lake	No treatment	.....	.....	.....	.....	.....	34.4	38.5	21.7	22.0
Cohoes [1] (23,433)	Mohawk River	Mechanical gravity filters and sterilization.	Filters and hypochlorite apparatus installed in 1911.	1888–1911	84.8	1912–1918	19.9	89.4	71.4	45.3	8.6
Corning [1] (13,459)	Dug well	Sterilization	Liquid chlorine plant installed 1915.	1898–1915	42.7	1916–1918	32.3	38.4	52.2	25.4	32.3
Cortland [1] (12,367)	.....do.....	No treatment	Gradual improvements to protect well.	.....	.....	.....	.....	32.4	28.6	18.5	9.8
Dunkirk [1] (17,870)	Lake Erie	Sterilization	Liquid chlorine plant installed May, 1914.	1898–1914	34.5	1915–1918	9.8	43.7	29.7	31.8	7.5
Elmira [1] (40,073)	Chemung River	Mechanical gravity filters and sterilization.	Filtered since 1896: hypochlorite used since 1911.	1888–1896 1897–1910	53.8 39.2	1911–1918	12.7	45.1	32.8	12.1	13.7
Fulton [1] (11,138)	Dug wells	No treatment	Gradual improvements to eliminate surface water and Oswego River water.	.....	.....	.....	.....	37.3	17.6	25.2	14.6

[1] Improvements in the public water supply made following investigations and recommendations of the department.

Water supply and typhoid fever in the cities of New York State—Continued.

City and population. (State census of 1915.)	Source of water supply.	Present treatment.	Remarks.	Typhoid fever death rates. (Average annual deaths per 100,000 population.)						
				Before improvement in water supply.		After improvement in water supply.				
				Years.	Average.	Years.	Average.	1901–1905	1906–1910	1911–1915	1916–1918
Geneva [1] (13,232)	Seneca Lake	Slow sand filters	Filters installed 1914	1898–1913	31.3	1914–1918	17.8	36.4	20.1	31.2	17.2
Glens Falls (16,323)	Surface streams and storage reservoir.	No treatment	Rules and regulations enacted 1912.					35.0	30.8	17.5	13.9
Gloversville [1] (21,178)	Surface streams and storage reservoirs.	Sterilization apparatus to be installed.	More effective patrol since 1912.					18.5	13.6	10.3	3.1
Hornell [1] (14,352)	Seeley Creek	Mechanical pressure filters and sterilization.	Filters installed in 1899; water supply rules enacted 1913; liquid chlorine plant installed 1915.	1890–1899	55.0	1900–1918	17.3	31.6	17.4	10.0	2.3
Hudson (11,544)	Taghkanic Creek and Churchtown Reservoir.	Slow sand filters	Filters installed in 1874; Hudson River source abandoned 1905; liquid chlorine 1914.	1898–1904	78.6	1905–1918	25.4	73.8	25.4	28.5	17.3
Ithaca [1] (16,750)	Six Mile Creek	Mechanical gravity filters and sterilization.	Filters installed in 1903 following typhoid epidemic; hypochlorite used since 1914.	1898–1903	78.4	1903–1915	17.3	90.1	15.2	23.1	11.6
Jamestown (37,780)	Driven wells	No treatment						27.9	23.1	14.3	5.0
Johnstown [1] (10,688)	Surface streams	Sterlization	Liquid chlorine installed 1918.					12.1	10.2	7.5	0.0
Kingston [1] (26,354)	Sawkill Creek	Mechanical pressure filters and sterilization.	Filters installed in 1898; hypochlorite plant installed in 1912.	1898–1911	19.6	1912–1918	21.7	18.2	23.1	19.9	26.5
Lackawanna [1] (15,737)	Lake Erie	Sterilization	Liquid chlorine plant installed in 1913.	1909–1913	4.3	1914–1918	3.9			5.0	2.1
Little Falls [1] (13,022)	Surface streams	Slow sand filter for portion of supply. Sterilization.	Liquid chlorine plant installed in 1916.	1898–1916	26.4	1917–1918	30.0	26.0	19.2	17.2	22.5
Lockport [1] (18,693)	Niagara River	Sterilization	Source changed in 1909 from Erie canal to Niagara River; liquid chlorine plant installed 1913.	1898–1908	57.2	1909–1913 1914–1918	33.2 19.9	53.8	47.8	33.1	28.1
Mechanicville (8,208)	Surface streams	Supply partly filtered in slow sand filter.	Filter installed in 1909	1901–1909	19.9	1910–1918	15.7	29.6	12.3	7.9	24.0
Middletown (17,381)	do	Mechanical gravity and pressure filters.	Filters installed in 1900	1894–1900	31.0	1901–1918	24.1	26.2	24.8	28.5	11.9

Mount Vernon[1] (37,583)	....do	Slow sand and mechanical pressure filters and sterilization.	Filters installed 1894; hypochlorite used since 1909 for Mamaroneck River source; liquid chlorine plant recently installed.	1898–1908	14.7	1909–1918	8.2	14.3	16.2	8.9	6.8
Newburgh (27,876)	Silver Creek and Washington Lake.	Sterilization	Hypochlorite used since 1914; liquid chlorine since 1916.	1898–1913	38.4	1914–1918	17.1	36.9	41.8	29.6	16.7
New Rochelle[1] (31,758)	Surface streams and driven wells.	....do	Hypochlorite used since 1913	1898–1913	16.6	1914–1918	4.9	24.9	20.1	6.8	3.0
New York City[2] (5,468,190)	Croton River, Bronx River, Byram River, surface streams, and driven wells.	....do	Hypochlorite plant installed in Croton aqueduct 1912; liquid chlorine treatment used since 1916.	1901–1912	15.1	1913–1918	5.6	18.1	14.0	8.1	4.3
Niagara Falls[1] (42,257)	Niagara River	Mechanical gravity filters and sterilization.	Water company supply and municipal supply filtered since 1912; water company supply partly filtered prior to 1912; hypochlorite treatment of municipal supply; liquid chlorine treatment of water company supply in each case since 1912.	1898–1911	128.4	1912–1918	19.8	145.1	108.1	60.4	8.0
North Tonawanda[1] (13,498)	....do	Sterilization	Liquid chlorine plant installed Nov., 1914; poorly operated.	1898–1914	36.8	1915–1918	27.0	32.1	43.7	45.2	26.1
Norwich (8,342)	Chenango Lake and surface streams.	Mechanical pressure filters and sterilization.	Filters installed in 1905; hypochlorite plant installed later.	1901–1905	11.9	1906–1918	7.6	11.9	0.0	17.5	3.8
Ogdensburg[1] (14,338)	St. Lawrence River	Slow sand filters	Filters installed in 1913 and source changed from Oswegatchie River.	1898–1912	50.0	1913–1918	17.8	55.5	41.1	23.4	19.1
Olean[1] (17,925)	Driven wells and Olean Creek.	Sterilization (wells). Gravity mechanical filters and sterilization.	Liquid chlorine for wells 1918; Olean Creek supply first used 1919.					20.4	14.5	11.2	3.4
Oneida (9,461)	Surface stream	No treatment						20.0	15.9	7.1	6.8
Oneonta[1] (10,474)	Oneonta Creek	Mechanical pressure filters and sterilization.	Filters installed since 1906; hypochlorite treatment 1914.	1899–1906	35.8	1907–1918	28.0	36.3	48.2	19.4	15.5
Oswego[1] (25,426)	Lake Ontario	Sterilization	Oswego River source abandoned for Lake Ontario in 1910; hypochlorite treatment; liquid chlorine since 1917.	1898–1910	45.4	1911–1918	14.3	48.0	53.6	17.5	9.0
Plattsburg[1] (10,134)	West Brook and reservoirs.	....do	Hypochlorite plant installed in 1915; liquid chlorine since 1916.	1898–1915	25.6	1916–1918	34.5	21.1	21.9	37.1	34.5
Port Jervis[1] (9,413)	Surface ponds and streams supplemented by Neversink River.	Sterilization of Neversink River supply when used.	Hypochlorite treatment of Neversink River water, when used, since 1914 and liquid chlorine since 1916.	1898–1913	36.1	1914–1918	8.0	60.4	33.3	21.0	3.6
Poughkeepsie[1] (32,714)	Hudson River	Slow sand filters and sterilization.	Filters installed in 1872, improved 1907; hypochlorite plant installed 1910; liquid chlorine plant installed 1913.	1898–1907	45.2	1908–1909 1910–1918	28.7 11.9	41.7	45.3	13.1	7.7

[1] Improvements in the public water supply made following investigations and recommendations of the department.

Water supply and typhoid fever in the cities of New York State—Continued.

City and population. (State census of 1915.)	Source of water supply.	Present treatment.	Remarks.	Typhoid fever death rates. (Average annual deaths per 100,000 population.)						
				Before improvement in water supply.		After improvement in water supply.				
				Years.	Average.	Years.	Average.	1901–1905	1906–1910	1911–1915	1916–1918
Rensselaer (11,210)	Hudson River	Mechanical gravity filters and sterilization.	Filters installed 1901; hypochlorite plant installed 1911; liquid chlorine, 1917.	1898–1901	102.6	1902–1910 1911–1918	46.1 6.8	62.3	33.0	7.4	5.9
Rochester (248,465)	Hemlock and Canadice Lakes.	Sterilization for Canadice Lake only.	Canadice Lake first used 1919.					13.6	13.0	9.5	3.3
Rome [1] (21,926)	Fish Creek	Sterilization	Source changed from Mohawk River to Fish Creek in 1909; liquid chlorine installed in 1916.	1898–1909	23.0	1910–1915 1916–1918	16.8 13.3	24.6	21.4	16.3	13.3
Salamanca (8,370)	Springs and driven wells	No treatment						12.4	27.0	9.8	10.9
Saratoga Springs [1] (13,792).	Loughberry Lake	Sterilization	Liquid chlorine installed 1919; more effective patrol since 1914.					40.1	23.3	30.1	18.7
Schenectady (80,381)	Large wells intercepting ground water flow to river.	No treatment	Use of Mohawk River water discontinued 1903.	1890–1903	86.0	1904–1918	9.5	26.2	11.0	8.1	5.2
Syracuse (145,293)	Skaneateles Lake	Sterilization	Liquid chlorine installed 1917; since 1906 watershed protected by revised rules more rigidly enforced.	1898–1906	19.7	1907–1916 1917–1918	13.9 8.7	14.4	14.9	12.2	10.1
Tonawanda [1] (9,147)	Niagara River	do	Liquid chlorine plant installed August, 1919.					23.3	46.9	30.5	14.1
Troy (75,488)	Surface streams and lakes	No treatment	Partial use of Hudson River water discontinued 1906.	1898–1906	55.7	1907–1918	24.1	45.7	27.7	23.1	23.9
Utica [1] (80,589)	West Canada Creek and small surface streams.	West Canada Creek water sterilized since 1914.	Since 1906 watershed protected by revised rules more rigidly enforced.	1898–1906	18.2	1907–1914 1915–1918	11.6 9.0	16.0	17.1	7.8	10.9
Watertown [1] (26,895)	Black River	Mechanical gravity filters and sterilization.	Filters installed 1904, following typhoid epidemic; hypochlorite used since 1911.	1898–1904	94.9	1905–1911 1912–1918	46.5 16.1	81.2	50.9	18.1	19.8
Watervliet [1] (14,990)	Normanskill	do	Source of supply changed to Normanskill 1918.	1898–1917	43.7	1918	20.1	56.6	32.5	49.8	20.1

White Plains (19,287)...	Driven wells, dug wells, and surface stream.	No treatment.....	Polluted wells abandoned and watershed improved about 1912.	.....	.....	.....	.....	9.5	14.9	14.6	1.6
Yonkers (90,913).....	Saw Mill, Sprain, and Grassy Sprain Rivers.	Slow sand filters and sterilization for Saw Mill River supply.	Two slow sand filter units installed in 1904; hypochlorite plant installed in 1910; two additional filter units installed in 1909 and two in 1915; liquid chlorine 1917.	1898–1904	11.8	1905–1909 1910–1918	7.2 8.0	11.2	10.6	8.5	3.5

[1] Improvements in the public water supply made following investigations and recommendations of the department.

Annual typhoid fever death rates per 100,000 population in New York State, 1885–1915.

1885	19.0	1897	19.4	1909	15.1
1886	20.4	1898	25.6	1910	15.0
1887	22.7	1899	22.4	1911	14.0
1888	24.9	1900	26.7	1912	11.8
1889	25.6	1901	23.4	1913	10.5
1890	26.1	1902	17.4	1914	8.8
1891	30.5	1903	21.5	1915	7.7
1892	25.8	1904	20.9	1916	5.9
1893	25.7	1905	19.2	1917	5.7
1894	24.7	1906	19.0	1918	5.4
1895	25.4	1907	19.8	1919	3.3
1896	22.6	1908	16.0		

Typhoid fever death rate per 100,000 population in the cities of the State (combined population, 8,234,738) for 1918=5.1.

Since, however, these two diseases are comparatively negligible factors in the State of New York as compared with other States, and notwithstanding that effective and interesting work has been carried on in New York, particularly on Long Island, the speaker prefers to leave this phase of the subject for discussion by others who have a wider experience in localities where these diseases have been more prevalent. The speaker wishes to emphasize one point, however, viz, that although the general reduction of mortality from malaria must be shared partly with the medical profession, resulting from both immunization and curative methods, the ultimate eradication of this disease must obviously rest principally with the engineering profession, whose activities are directed primarily toward removing the cause or infective agents and whose work in this respect is more truly preventive and permanent than the work of the medical profession.

In the case of yellow fever, one of the problems, of course, is the elimination of the breeding places of the yellow fever mosquito around habitations. Although these water-borne and mosquito-borne diseases are the more important ones associated with engineering activities, the value of which may be largely measured in terms of decreasing mortality rates, there are other diseases whose declining mortality rates or ultimate eradication will undoubtedly more and more fall within the province of the sanitary engineering profession owing to engineering features involved. Furthermore, there are other engineering activities which, while not having a direct and measurable effect in decreasing the death rate, do, nevertheless, have an indirect effect.

In the control of such diseases as typhus fever and bubonic plague, the work of the physician will necessarily, or at least advantageously, have to be supplemented by work of the engineer. Whether it be the establishment and operation of fumigating stations, field work in eradicating the parasite of infection or transmission, or executive work in carrying out other protective or corrective measures, his services will, in the opinion of the speaker, be increasingly demanded, particularly as the value of engineering, administrative, and executive qualifications in these fields becomes better known and better appreciated.

In the second instance the speaker refers to certain strictly engineering lines of work which have an indirect effect in promoting health, or, conversely, in lowering the death rate. Without attempting to suggest a discussion of the Mills-Reincke-Hazen theories, we all recognize the fact that in furnishing pure water we not only eliminate water-borne diseases such as typhoid fever, cholera, and dysentery, but apparently contribute, in other ways not yet deter-

mined, to the good health and well-being of the community. We recognize, too, that the introduction of sewerage systems reduces opportunities for infection of wells; that purification of municipal sewage reduces dangers of infection from bathing and infection of milk from wading of cattle; that purification of water in swimming pools reduces the dangers of transmitting infections to bathers; that milk pasteurization, now a well-developed activity of engineering divisions in some States, reduces the mortality from milk-borne infectious diseases. In fact, we know that in all of these engineering activities just referred to there must result indirectly a material reduction of the general death rate whether we can differentiate and measure it by means of mortality statistics or not.

In conclusion, the speaker feels that as a higher efficiency is attained in methods of diagnosis and in the reporting and recording of vital statistics, a truer and more accurate index will be furnished of the influence which sanitary engineering activities exert in reducing the general death rate, and a greater appreciation given to the value of engineering services generally in the field of public health work.

STATE SANITARY CONTROL OF PUBLIC WATER SUPPLIES AND SEWERAGE SYSTEMS.

W. H. Dittoe,
Chief Engineer, Ohio State Department of Health.

The benefits to be derived from efficient control of sanitary improvements by State departments of health have been demonstrated by the experiences of a number of States in which such control has been exercised for varying periods of time. The results of such control have been shown to be of great value to the public, not only in accomplishing a marked reduction in mortality, but also in permitting the establishment of broad policies, adherence to which results in more complete and proper utilization of natural resources, as well as a considerable saving in cost of improvements. By placing such control in the hands of a central authority there has also been created a means for the collection and interchange of information helpful in connection with the installation and operation of sanitary improvements. I do not consider that it is necessary for me to present a plea for State control, and I shall therefore attempt to outline what in my opinion should be the extent, nature, and method of such control.

Three main features of control are necessary to accomplish adequate jurisdiction over sanitary improvements. The first and most important feature is enforcement of legislation requiring approval

by the State department of health of plans for all improvements of a public or quasi-public nature involving water supply and sewerage. The second, and almost equally necessary, feature is legislation providing for State supervisory control of maintenance and operation of such improvements. The third necessary feature is legislation providing for the issuance and enforcement of orders by the State department of health requiring water supply and sewerage improvements which are necessary to protect the public health.

I shall endeavor to set forth briefly an outline of the more important considerations to be given to these three features:

APPROVAL OF PLANS.

The law should prohibit the installation of any improvement involving water supply or sewerage for public or quasi-public purposes until the State department of health has approved such proposed improvement or the plans and specifications therefor. While it is primarily necessary that such legislation apply to the municipalities and other centers of population, the broadest scope should include every possible place where the public can be served. This would comprise municipalities or parts thereof; unincorporated communities; water and sewer districts outside of municipalities; realty allotments; resorts, parks and camps; national, State, county, district, and municipal public institutions; privately owned institutions; universities, colleges, seminaries, schools, and other educational institutions; churches, hotels, clubs, and factories; steam and electric railroad stations and trains; and all other public and quasi-public places used for the assemblage or employment of persons. For such places the law should require the submission of plans covering the following classes of improvements:

1. New and additional water supplies and extensions and changes thereof.
2. Water filtration and treatment plants and extensions or changes thereof.
3. Waterworks systems and extensions or changes thereof, including installations for obtaining, pumping, storing and distributing the supply.
4. Sewerage, sewerage systems and extensions or changes thereof.
5. Sewage treatment and methods of sewage disposal and extensions and changes thereof.
6. Methods of treatment and disposal of industrial wastes and extensions and changes thereof.

It may be advantageous to mention some of the more important items which should be observed in passing upon plans submitted for approval. It is evident that all features should be carefully scrutinized which may have any bearing upon the safety and efficiency of

the improvement from the standpoint of public health and sanitation. It is believed that the following general principles should be applied in considering proposed water supply improvements:

1. Dual water supplies should not be permitted, nor should a municipality be allowed to install a water supply, unfit for domestic use, with the proposal that the supply is for fire-protection purposes only. In other words, the public water supply should be one suitable for all uses, particularly drinking and domestic purposes.

2. No emergency water supply which is contaminated or subject to contamination should be permitted.

3. The adequacy of the proposed water supply and its development should be demonstrated beyond a reasonable doubt, taking into account the future requirements to be placed upon it. The supply and its development should be adequate to furnish not only the domestic demand but also all other legitimate demands for water, such as industrial consumption and fire protection, otherwise the use of an emergency supply is likely.

4. The quality of the water supply must be satisfactory and in addition to the hygienic quality, which is of prime importance, due consideration should be given to physical quality (color, odor, turbidity, taste), and to chemical quality (salinity, hardness, acidity, and iron). While the State department of health should not be charged with the control of other than sanitary features, it is pertinent to recognize that the standard of a public water supply demands a high scale of quality from all standpoints.

5. The development of the water-supply improvement must be safe. Due assurance must be had that the supply will be protected from surface and subsoil drainage, from flood water, and from contamination due to leakage into reservoirs and clear wells, and due to exposure in open reservoirs. The design of such purification processes as may be necessary should be in accordance with accepted practice and should be such as to give full assurance of the efficiency of the purification to be effected. By-passes for unpurified water should not be permitted.

6. As a whole, the works should be designed to facilitate maintenance and operation, as difficulties in operation frequently destroy efficiency. Unnecessary frills should be avoided.

In considering plans for sewerage improvements the following are some of the more important general principles:

1. The type of sewerage system should be selected to meet the local needs, considering the future development of the territory. While separate systems are applicable in practically every instance, this is not true of combined systems which are preferable only under certain circumstances.

2. The adequacy of the sewer design should be carefully analyzed, with due consideration of the period of design and of the assumptions used in forming a basis.

3. The suitability of details which may affect the maintenance and usefulness of the system should be studied with care, such details including hydraulic features, manholes, jointing, and other special features.

4. The purpose for which a sewage treatment plant is to be installed should be clearly understood and the required accomplishment of the plant should be determined as accurately as possible. Knowing these facts the adequacy of the plant to accomplish the results, should be carefully studied.

5. The design of sewerage systems and sewage treatment plants should be simplified to facilitate maintenance and operation. This feature is one of the most important ones to be considered in passing upon plans for sewage-treatment plants.

SUPERVISORY CONTROL OF MAINTENANCE AND OPERATION.

The law should require that the maintenance and operation of water supply and sewerage improvements of the classes previously described shall be satisfactory to and subject to control of the State department of health. It should also provide for the submission to such department of records maintained by the local authority. As local regulations are also necessary to insure proper maintenance and operation, there should be a means of State control of such local regulations in order to insure their applicability. Without attempting to discuss details of the method of accomplishing this result, I desire to present some of the more important considerations to be given in control of maintenance and operation. With respect to water-supply improvements, the following appear to be necessary:

1. Local ordinances and regulations must be enforced to prevent contamination of water supplies by encroachment of privies, cesspools, and other sources of contamination, and in addition regular patrol of the watersheds of surface-water supplies should be maintained.

2. Water purification and treatment plants should be operated under the supervision of a competent and experienced person, with analytical control of operation, and daily records should be maintained and submitted to the State department of health, which department should have the power to require changes in operation, as may be necessary.

3. The maintenance of storage and impounding reservoirs, wells, conduits, receiving basins, distributing reservoirs, standpipes, and other portions of a waterworks system, should be subject to the

direction of the State department of health, and when necessary orders should be issued and enforced requiring necessary changes and improvements in maintenance and operation.

4. A frequent menace to the safety of a water supply is the existence of connections on the distributing system to premises for which independent water supplies of unsafe quality are maintained. Interconnections of this kind should be prohibited by State or local regulation.

5. As the benefits of a good water supply can not be realized fully unless such supply is universally used, local regulations should be enforced, requiring connection to the mains and abandonment of private wells and other unsatisfactory sources of water supply.

6. Frequently the wastage and leakage of a water supply results in overburdening a purification plant or other equipment and rendering the water supply inadequate. Restrictions upon wastage and leakage should be enforced by local regulation.

The following considerations are of importance in regard to maintenance and operation of sewerage improvements:

1. However carefully a sewerage system is designed, its benefits can not be realized unless it is used properly. Local ordinances and regulations should be enforced, requiring sewer connections, providing for control of the establishment of sewer connections and prohibiting misuse of sewers, such ordinances to be approved by the State department of health before they are enacted.

2. A trouble of frequent occurrence is the clogging of connections from combined sewers to intercepting sewers, resulting in the passage of the dry weather sewage flow through the storm-water outlet. Efficient and regular inspection by the local sewer department is necessary and should be required.

3. The maintenance and operation of sewage pumping and treatment equipment are very frequently neglected, and as the duties connected with such work are usually distasteful to the public officials, there should be adequate legislation permitting the State department of health to require by proper orders the necessary maintenance and operation of such improvements.

ENFORCEMENT OF ORDERS REQUIRING IMPROVEMENTS.

In addition to legislation providing State control of proposed and existing improvements, it is necessary that legislation be provided to permit the application of the police power of the State in enforcing the installation of sanitary improvements which are necessary to protect the public health. If such legislation does not exist, there is no means of requiring correction of impure water supplies and of stream pollution, except upon the initiative of the mu-

nicipality or persons who are responsible for the maintenance of the unhealthful conditions. Legislation should be enacted which will permit orders to be issued and enforced by the State department of health, covering the following cases:

1. Requiring the installation of improvements to provide an adequate and safe water supply in case the public health is endangered by the absence of a supply, the maintenance of an impure supply, or the maintenance of an inadequate or unsafe system.

2. Requiring the installation of sewerage and improved sewage and industrial waste disposal in case the public health is endangered by the absence of sewerage, the maintenance of inadequate or unsatisfactory system, or the improper disposal of sewage or industrial wastes.

3. Requiring the extension of water mains and sewerage when necessary to protect the public health.

It is important also that such legislation provide means whereby the funds can be secured for the carrying out of such orders. If there is a statutory limitation on indebtedness of political subdivisions of the State, the legislation should include exemptions by which the necessary funds can be raised outside of the statutory limitations.

I have endeavored to outline as completely as possible the principal features of State control of sanitary improvements which are necessary to provide effective supervision. It is recognized that the features as outlined cover a broad field and that it may be impossible to undertake all features of State control at the same time. It is believed, however, that complete State control will ultimately be found advisable and will eventually be adopted in any State which attempts partial control of sanitary improvements. The carrying into effect of State sanitary control, either on a partial or on a complete basis, will necessitate the maintenance of an efficient engineering organization and will require untiring effort on the part of the individuals forming such organization if good results are to be secured.

WATER QUALITY CONTROL.

William Firth Wells,

Biologist and Sanitarian, New York State Conservation Commission.

Any comprehensive program for the conservation of water—our greatest natural resource—must recognize the primary value of quality in water. Whereas development of navigation, irrigation, and water power is possible by control of the available quantity of water through regulation of the flow, its value for water supplies,

industrial purposes, fisheries, recreational purposes, and waste elimination depends upon the control of the quality of water by the regulation of wastes. "In considering the uses of water and consequently the expenditures which may be made in conservation by storage, we may divide these uses into five classes: First, support of life; second, production of food; third, carrying away wastes; fourth, manufacturing, including water power; fifth, navigation."[1]

Biological and chemical problems, as well as engineering, are important considerations in the first four classes, and efforts have been made to prevent, as far as possible, injury to the value of water which depends upon its quality.

Lack of systematic effort is the principal reason for the slow progress in the elimination of pollution. Quality control is as definite as the inverse problem of regulation of flow. The positive value received in the use of a stream for waste disposal is the saving of a negative value—the cost of treatment. The problem is one of regulation rather than prohibition, for no one standard can apply to waters used for various purposes nor is a uniform treatment of wastes demanded under differing conditions.

If the accumulated chemical knowledge of the requirements of water were expressed in comparable quality units, much existing confusion would be eliminated. Since all wastes are harmless in sufficient dilution and the dilution possible in a stream without injurious effect determines the permissible limits of pollution, it is suggested that dilution be accepted as the fundamental quality unit of measure. The dilution equivalent or effective dilution of treatment processes can be defined in the same terms, when it becomes possible in any given case to determine very simply the relation existing between the requirements demanded and the means and cost of solution. Such a simple system of common understanding would be a most important factor in a united quality conservation program.

There are evidences that the time is approaching when different forces will unite to cooperate in one general harmonious program. The report of the Royal Commission on Sewage Disposal of Great Britain vividly portrays the necessity for such central direction, and in a general manner the recommendations indicate the only effective means by which progress can be directed. While it is not necessary to officially unite the multitude of agencies concerned in and working upon the problem, it does seem essential that some central authority be responsible for guiding efforts toward harmony.

In New York State the conservation commission can logically take this broad interest in the pollution of waters. By recogniz-

[1] "Water Resources—Present and Future Uses." (F. H. Newell.)

ing quality control by the regulation of wastes as a conservation problem, analogous to regulation of stream flow, the commission can fulfill many needs in making water protection more effective. In this way an intermediary cooperative agency is created capable of developing the greatest value of individual effort.

Under the present conservation law the commission has a broad jurisdiction over the quality of waters and an effective machinery for enforcing the law. All sewerage applications must be approved by the commission. The equitable distribution of water-supply resources is effected by issuing permits. Under the division of fish and game an efficient force of protectors is continually patrolling the streams, which is always alert to enforce such administrative regulations as prevent the destructive abuse of the waters. The commission also maintains numerous hatcheries where fish are propagated for planting in State waters, so as to overcome the natural depletion brought about by increased fishing. In the last few years the legislature has made an appropriation for the investigation of the effects of pollution and means of remedying the same, thus enabling the commission to enforce these laws intelligently.

A specific administrative program has been adopted for guidance in the work. Even with the incomplete knowledge at present available, much can be accomplished in administrative action. The following classification of wastes demanding similar administrative action has been taken from this program:

TYPE I.—INNOCUOUS WASTES.

Innocuous wastes are those that do not appear to be sufficiently detrimental to require action by the commission. Under the provisions of the law the commission has an opportunity to examine all new cases of this sort as they arise, and if it finds that they are, in fact, innocuous no further action than the granting of a permit is necessary. In the case of existing industrial establishments it is necessary only for the commission to determine their innocuous character.

TYPE II.—SANITARY SEWAGE.

Sanitary sewage is in many cases extremely detrimental from every standpoint, the most important objection to it being its effect upon public health. The State department of health is making excellent progress in bringing about the installation of sewage-disposal plants operated by municipalities. The pollution of the streams of the State by sanitary sewage is on this account decreasing at a very satisfactory rate. The commission has jurisdiction over pollution by sewage as affecting potable waters, fish hatcheries, and

fish or shellfish in the marine district. The commission will, wherever possible, cooperate with the department of health in such cases and in general educational work to encourage the proper handling of sanitary sewage by municipalities. Sanitary sewage would not be classified under this type if mixed with so great an amount of detrimental trade waste that the latter becomes the controlling factor, thus putting that particular case of pollution into Type III, or IV, below.

TYPE III.—PROHIBITED WASTES.

Certain kinds of waste are so detrimental even in great dilution that they should, in general, not be allowed to enter public waters. Often these wastes are produced in the course of manufacturing processes independently of the use of the water. The practice heretofore has nevertheless been to dispose of them by finally turning them into the stream as the easiest method of their disposal. It is clear that the simplest method of preventing the injury due to these wastes is to exclude them completely from the stream. This can usually be done with facility and often with profit to the industry.

The prohibited wastes may be divided into two subtypes as follows:

A continuous prohibited waste.—This subtype of prohibited wastes consists of those that are discharged with such frequency as to produce in the stream a more or less constant intensity of pollution. Biologically, evidence of their presence is usually found in partial or total absence of life in the polluted section of the streams at all times. The best example of this type of pollution is the discharge of sawdust into a stream.

A periodic prohibited waste.—This subtype includes those wastes that are not a continuous daily product of an industry, but that nevertheless reach the stream from time to time, either intentionally or by accident. There may be abundant fish and other aquatic life in a stream for a long period, but upon periodic prohibited waste being discharged, there is usually a large and sudden mortality of fish. There may then be time for the stream to recover, partially or wholly, before another discharge of the pollution. An illustration is a pile of spent carbide from an acetylene gas plant, poisons from which reach the stream only when rain falls and leaches through the carbide. The periodic dumping, either intentional or accidental, of such wastes into public waters is a frequent cause of great and conspicuous destruction of fish.

TYPE IV.—TRADE WASTES REQUIRING TREATMENT.

A great many trade wastes, which prove detrimental when untreated, are capable of such treatment that the resulting effluent is

innocuous. The wastes under this type are usually those introduced into the water through the use of the water in the actual processes of manufacture. This means that such wastes, because of their admixture with large quantities of water, must undergo a treatment process for the purpose of removing them from the water before the water is returned to the stream, or rendering them innocuous without actual removal from the water. In some of these cases a bi-product may be obtained as the result of treatment, which has an actual, financial value.

Two subtypes are recognized as follows:

A. *Wastes requiring treatment known, practicable and effective.*—The best illustration of a waste under this subtype would be sanitary sewage except that, on account of the limited jurisdiction of the commission over such pollution, it has been classed as a special type. The commission proposes to study, or encourage the study of, methods of treating wastes, and the result of carrying out this part of the program will be to enlarge the number of wastes coming under this type. While the handling of cases of pollution under this subtype presents problems of a scientific nature, the chief task is the administrative one of securing treatment.

B. *Trade wastes requiring further study.*—The method of treatment of many detrimental trade wastes, which it is impracticable to dispose of otherwise than by running into streams, is not fully worked out. The wastes in this subtype are so many, and the damage that they do is so extensive, that their gradual elimination must constitute one of the most important and difficult phases of the work. Here, as at other points throughout this program, one of the guiding principles to be followed is that of directing action toward ends that are possible of accomplishment without serious detriment to industry. For instance, there is the question whether the wastes of a particular industry can at the present time not be excluded from public waters or made innocuous without a serious impairment of that industry. This plan contemplates that the industry be advised that it is violating the law and that the responsibility for studying methods of purification of its wastes rests upon it. The commission will cooperate with the industry to the end that required purification be brought about in every possible and proper manner.

COORDINATION OF THE CONTROL OF DRINKING WATER ON INTERSTATE CARRIERS WITH ENGINEERING FUNCTIONS OF STATE DEPARTMENTS OF HEALTH.

C. M. Baker,

State Sanitary Engineer, Wisconsin State Board of Health.

The certification of water supplies of interstate carriers by the United States Public Health Service, in cooperation with the various State boards of health, has been a matter of considerable contention for a number of years. In certain States the laboratory procedure has not precisely conformed to the standards of the Treasury Department and the State officials have not felt justified in modifying their methods so as to meet these requirements. Furthermore, some of these States have made rather complete sanitary surveys of their public water supplies, which, together with the analytical data, furnish more definite information on which to judge the quality of the supplies than that required by the Treasury standards; nevertheless their methods have not conformed entirely to these standards. Other States have practically no facilities for either obtaining analytical data or making sanitary surveys. In view of these discrepancies, difficulties have been encountered by the Public Health Service in securing satisfactory certification of water supplies of common carriers. Various modifications of the required procedure have, therefore, been made by the service from time to time.

The Act of Congress which provides for the control of water supplies of interstate carriers entitled "An act granting additional quarantine powers and imposing additional duties upon the Marine Hospital Service," was approved February 15, 1893. Section 3 of this act provides "That the supervising Surgeon General of the Marine Hospital Service shall * * * examine the quarantine regulations of all State and municipal boards of health and shall * * * cooperate with and aid State and municipal boards of health in the execution and enforcement of the rules and regulations of such boards and in the execution and enforcement of the rules and regulations made by the Secretary of the Treasury to prevent the introduction of contagious and infectious diseases * * * into one State or Territory or the District of Columbia from any State or Territory or the District of Columbia." It further provided that if the local regulations are inadequate the Secretary of the Treasury shall "make such additional rules and regulations as are necessary to prevent the introduction of such diseases," which shall be enforced by the local authorities except in case they decline to assume these duties or fail in their execution when the President shall execute and enforce the same.

In conformity with the provisions of this act the Surgeon General of the United States Public Health Service, through the Secretary of the Treasury, has promulgated interstate quarantine regulations which include regulations for the control of water supplies on interstate carriers. These regulations required that the water conform to the "bacteriological standard of purity for drinking water supplied to the public by common carriers in interstate commerce," which was promulgated by the Secretary of the Treasury on October 21, 1914. These standards outline a definite procedure in analyses for the determination of B. coli and the total bacteria on agar at 37°. Since this paper is to discuss mainly the engineering functions, however, only the requirements of these rules will be stated, namely, that the water should not contain more than 100 bacteria on the agar plate at 37° nor in excess of 2 B. coli per 100 c. c. No provision was made for deviation from this standard nor was any sanitary survey required, the quality of the water being passed upon by analyses only. With reference to handling water certain requirements were made regarding the use of clean ice, cleaning the containers, etc., but the ice was allowed to come in contact with the water itself. An amendment of these rules and regulations was later enacted on February 12, 1917, the requirements of which, however, were substantially the same as those of the previous regulations except with reference to the procedure of the common carriers in securing certification of the water.

It should be borne in mind that these early regulations were put into force at a time when few if any of the States had adequate facilities for proper control of their water supplies by sanitary surveys, and that in many cases even suitable laboratories were not available. In fact, a survey of the facilities of the various States for the control of water supplies by the United States Public Health Service early in 1919 showed that less than one-half of the States were well equipped for this work, 12 of the remainder had no sanitary engineers, but were equipped with meager laboratory facilities, while one State had neither an engineer nor laboratory. It is obvious, therefore, that although some States are well qualified to control their own public water supplies, and in connection therewith those of all common carriers, general control by the United States Public Health Service is still essential. The purity, not only of public water supplies, but also of those of common carriers within the State, should, however, be of prime interest to the State itself, because of the great danger to the inhabitants thereof when these supplies are impure.

On account of the value of sanitary surveys, and for the purpose of securing better coordination of this work between the States and the Public Health Service, the rules and regulations were again amended on July 14, 1919.

This new amendment requires that "water provided for drinking and culinary purposes * * * shall be from a source which is certified and approved as producing water of satisfactory quality and safety," the certificates are to be based upon freedom from contamination, as determined through a sanitary survey and the results of the bacteriological and chemical analyses, by methods approved by the United States Public Health Service. These certificates of examination may be issued by officers of the service or by the State departments of health, and shall be filed semiannually in March and September of each year, except where constant supervision of the supplies is maintained by the State authorities, in which case annual certification may be approved by the Surgeon General. The water shall be so handled as to prevent pollution and shall be cooled in such a manner that ice can not come in contact with the water.

"Recommendations regarding data upon which certification is based" are printed upon the back of the standard form of certificate and recommend—

1. "Standard method of water analyses," A. P. H. A.

2. That both data of the sanitary survey and the analyses be recorded on the certificate where available, although "certificates based upon only bacteriological or chemical data, respectively, may be submitted with the approval of the Surgeon General."

3. That the regional "normal" be given with chemical analyses.

4. The method for bacteriological analyses promulgated by the Secretary of the Treasury on October 21, 1914, be used for the average supply.

5. Favorable certificates based upon bacteriological data not conforming to this standard "must particularly show in the sanitary survey data reasons wherefore such excess is believed to be without sanitary significance."

The new rules and regulations, therefore, largely eliminate the old objection since more latitude is given the various State officials in their method of control, provision being made for basing interpretation of the analytical results upon sanitary surveys also for modification of the methods of analysis. The requirement that the supplies of common carriers be certified semiannually in March and September of each year, however, seems somewhat impractical, because it is impossible in many States to make the necessary sanitary surveys within one month's time, and unless this is done the certificate must be based upon obsolete data.

It is believed that the control of the water supplies of common carriers as well as of all public supplies should be mainly if not wholly under the supervision of the respective State departments

of health, providing these departments are adequately equipped for such control. The equipment for this control should consist of a well organized and efficient division of sanitary engineering which should have direct supervision of water supplies as well as of other engineering matters. Either as a part of this division or cooperating with it should be a water laboratory. The engineering personnel should be sufficient to make annual sanitary surveys of all ground-water supplies and more frequently when there are potential dangers of pollution also, quarterly sanitary surveys of all surface supplies or where purification is necessary, except in case municipalities themselves maintain satisfactory scientific control. In connection with all these surveys samples should be collected for analysis, and in some cases more frequently. It is generally conceded that a sanitary survey is essential for intelligent interpretation of water analyses. The analytical results should, therefore, in order to prevent discrepancies between the two divisions, be transmitted to the engineering division for interpretation and not sent directly to the local authorities from the laboratory.

There are three points that we have endeavored to bring out in this paper, which may be summarized as follows:

1. The present regulations governing the certification of water supplies of persons, firms, or corporations engaged in interstate traffic provide a satisfactory basis of cooperation between the United States Public Health Service and the various State officials, except that certification should not be confined specifically to the months of March and September.

2. As soon as a State has adequate facilities and is ready to assume control of these supplies, however, they should be given complete control over them.

3. In those States where such facilities are not available, the United States Public Health Service should retain control and, in cooperation with State officials, should endeavor to build up the necessary organization. In this connection, the service should be in position to furnish engineering and laboratory personnel to assist these States. In connection with this work, assistance could be given not only in the control of water supplies of common carriers but also in building up effective State organizations for the control of sanitary conditions generally within the State.

THE SANITARY PROTECTION OF SHELLFISH.

RICHARD MESSER,
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In the short time of 15 or 20 minutes allotted, it is possible to give only a brief outline of the problem and to call attention to the certain matters which from now on should be given serious consideration by the members of this section. Investigations of shellfish areas and the methods of handling during the past 10 years will serve as a basis for future policies. Although the direct supervision of the industry must necessarily fall on the health officials of those States bordering on the coast, nevertheless, the subject is of national interest because of the wide distribution of these food products.

Most of you are familiar with the reports by the Public Health Service covering the detailed and comprehensive investigations made under the direction of Surgeon (now Surgeon General) Cumming; the first one of the pollution of the Potomac River and since then of the coastal waters from Virginia up to New York.

The magnitude of the industry and its relation to the economic interests and health of the country may be indicated best by quoting a few statistics. In Chesapeake Bay and its tributaries there are approximately 800 square miles of oyster-bearing areas, from which there are taken each year at least 15,000,000 bushels of marketable oysters, valued at $15,000,000. Next in importance are the areas bordering New York State and then the grounds in Delaware Bay and along the New Jersey coast. There are also holdings along the Atlantic south of Virginia and the waters of the Gulf.

The subject of sanitary protection may be discussed under two separate heads, first the purity of the waters from which the oysters are taken for market purposes and second, the care in handling and packing. This paper is limited principally to the discussion of the first of these, which involves questions of sewage treatment, self-purification of streams, and tidal flows, which are essentially problems of an engineering nature.

As is brought out clearly in the reports above referred to, oyster beds may be listed in three general classes, (1) those located at some distance from the shore line and having a depth of water ranging from 15 to 50 feet; (2) grounds in tidal estuaries, at the mouths of creeks and near shore, with depths of water not exceeding 15 feet (the maximum depth in which tongs can be used effectively); and (3) areas in the larger rivers, such as the Potomac, Delaware, and the James.

The relative probability of pollution of the coastal waters in the first two classes is best indicated by quoting from Dr. Cumming's

report "that of 400,000 to 500,000 acres of shellfish producing areas in the Chesapeake under the jurisdiction of Virginia and Maryland only 2,000 to 2,500 acres, or 0.5 per cent, were found to be polluted, and practically all of these were grounds in shallow waters, as described under the second classification. All these areas have since then been condemned, and the taking of oysters for market purposes therefrom is prohibited.

With regard to the deeper waters some distance out from shore, the factors which account for the absence of pollution are the settling of the grosser sewage particles in the vicinity of the sewer outlets and dilution and dispersion of the colloidal matter and bacteria by tidal currents. However, actual and repeated observations by means of floats and bacteriological examinations are necessary to prove that these grounds under class 1 are practically free from pollution.

As a general proposition, the sanitary survey is sufficient to judge whether shallow areas are safe, although, of course, bacteriological examinations must be made to confirm an opinion.

From a sanitary engineering viewpoint the grounds in rivers are of special interest. The problem, in brief, is to determine at what point below the sewer outlets from a given city pollution practically disappears; in other words, the self-purification of the stream. It is not necessary to discuss the various factors involved, although it may be well to draw attention to the fact that in streams subject to tidal action the time required for the sewage to travel a given distance from the point of discharge is much longer than for inland streams. As was done in the case of the Potomac, it is possible to determine the limits of pollution with a fair degree of accuracy.

The handling of oysters will be discussed only briefly. The practice of floating or fattening is now prohibited in Virginia by law. The same is true with regard to drinking oysters except in a few special instances and by permit. The reasons are of course due to location of floats in polluted waters or the use of impure fresh water.

The experiments by the Public Health Service in "drinking" oysters in water kept pure by chlorination or by other methods are very promising. It is a well known fact that within a few hours after a live oyster is placed in clean water at proper temperature, it will eliminate practically all of the foreign matters and sewage bacteria. The only difficulty is the extra cost of handling and for purification. This problem is one for us engineers to solve.

Right here it is proper to say that reputable oystermen and packers will offer their fullest cooperation with the object of making their products safe. They are more interested than we are to protect the industry which is of such economic value to the country.

SUPERVISION OF SHELLFISH AREAS IN VIRGINIA.

In Virginia the State board of fisheries is charged with the conservation and protection of all shellfish areas and the State dairy and food department is required by a special act to examine areas and establish limits of pollution and to issue certificates covering waters which are safe.

At the present time the commissioner of fisheries has the personnel and facilities for the effective control of shellfish removal either by transplanting of seed oysters or the taking of oysters for market purposes. The law requires that transplanting from public rock situated within a polluted area to cultivated beds shall be done between May 15 and August 15. With regard to private grounds, transplanting is done by permit, which provides that the oysters shall remain in pure water at least seven days before being taken for market purposes.

From this it will be noted that the State board of health has practically no authority over this industry. In 1916, an effort was made to secure the passage of an act to regulate the disposal of sewage, but without success. Since then there has been a decision rendered by the Virginia Supreme Court and confirmed by the United States Supreme Court which is of vital importance to the industry not only in Virginia but perhaps in all the States. A brief summary is given as follows:

Summary of decision by Virginia Supreme Court of Appeals Darling *v.* Newport News (123 Virginia, 14—June–November, 1918:

There is a marked and well defined distinction between the pollution of a small nonnavigable stream and the pollution of large tidal navigable bodies of salt water for the reason that in the first case the bed of the stream and the waters are owned by riparian owners, while in the latter case the bed of the navigable tidal salt water and the waters themselves are owned and controlled by the State, for the use and benefit of all the public, subject only to navigation. It is for the State to say what uses shall be made thereof and by whom, subject always to the right of the public, and for the State, through the legislative branch of the government, to say how much pollution it will permit to be emptied into and upon its waters so long as the owners of the land between low water and high water marks are not injured.

A municipal corporation situated on the arm of the sea, adjacent to tidal water, has the right to use such waters for the purposes of carrying off refuse and sewage to the sea, so long as such use does not create a public nuisance, and any injury occasioned thereby to private oyster beds is damnum obseque injuria.

The power of the sovereign State or Nation is perpetual, not exhausted by one exercise and all privileges granted in public waters are subject to that power, the exercise of which is not the taking of private property for public use, but only the lawful exercise of a governmental power for the common good.

The decree goes on to say that any leases granted for the planting or propagating of oysters in tidal waters do not in any way disturb

any prior State rights with regard to the use of waters for the discharge of sewage and wastes, etc.

This case was argued in the United States Supreme Court on April 15, 1919, the decision being summarized as follows:

Generally speaking, private rights in land under tidal waters are subject to the right of the State to use such waters as a depository for sewage.

Plaintiff held oyster beds in the tidal waters of Hampton Roads by leases from the State of Virginia, under whose laws, as long as he paid rent, he was declared to have the "exclusive right to occupy" the land for 20 years, subject to any rights of other persons previously acquired, with the State's guaranty of the "absolute right" to continue to use and occupy it for that period. Held: That the grant, construed strictly, with reference to the public necessity in that vicinity and previous pollution of the water, was subject to the right of the State to authorize the city of Newport News to discharge its sewage into the Roads, and that the consequent pollution of the plaintiff's oysters was neither (1) taking of his property without due process; nor (2) an impairment of his contract rights; nor (3) (following the State court) a damage in the sense of the Virginia Constitution which requires compensation for property taken or damaged for public use.

The above decision, of course, is a serious blow to many of our oyster planters, as in all probability some of their most valuable holdings may have to be condemned within the next few years as the quantities of untreated sewage from nearby cities increase. The thought occurs to me that the question of the purity of waters over oyster areas is very similar to that of public water supplies. A few years ago there was a tendency to treat all municipal sewage in order to maintain the purity of streams from which public water supplies were taken. Since then many of the States have adopted the policy of requiring only such treatment of sewage as is necessary to prevent any danger of overloading the water purification plant below. The water purification plant is what is relied upon to produce a safe and satisfactory supply.

For the same reason why should not oysters be purified by cleaning in pure water just before being packed for shipment. If a practical scheme can be devised it may mean that the standards concerning the bacterial quality of the waters over the beds may be changed somewhat. Of course, under no circumstances should oysters for market purposes be taken from grossly polluted beds no matter what method of purification is used. On the other hand, it would not be necessary to condemn an area which is only slightly polluted as indicated by bacteriological examinations.

The problem of working out a plan by which oysters can be cleaned in basins of artificially purified water should not be difficult. In its simplest form the plant would include a basin in which chlorinated water would be kept in constant circulation by means of pumps. The arrangement might be very similar to the one adopted for swim-

ming pools in which the same water is used for a number of days and sometimes several weeks. At any rate the results of experiments which have already been made are so good as to justify further study as to details and costs.

MOSQUITO CONTROL AS AN ENGINEERING UNDERTAKING.

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THE IMPORTANCE OF MOSQUITO CONTROL.

The mosquito problem is of national scope and is a social-economic as well as a public health problem. As the agent of the spread of malaria and other protozoal diseases, such as yellow fever, dengue, and filariasis, the insect is the cause of the crippling and debilitation of hundreds of thousands of people annually in this country, and directly or indirectly of the death of not a few score thousands of these. The sum of the economic losses to this Nation due to the ravages of malaria, in view of the long, often interminable periods of enervation of the persons attacked, is probably second to that of no other disease, excepting only the recent pandemics of influenza. In the State of Mississippi there were reported, in 1916, 158,751 cases of malaria and 1,426 deaths, from which it was estimated that more than 400,000 cases of malaria were actually occurring each year in that State amongst a population of 2,000,000; an average of one person in each five is annually attacked. For comparison it may be stated that an estimate by Mr. George A. Johnson for typhoid fever for this same period was 200,000 cases annually in the whole country. It is well-nigh impossible to gauge the extent of malarial infection throughout the land which some would place around three-fourths to one million cases per year. The disease is definitely known to be endemic in pretty nearly a third of the area of the United States. The damage wrought by malaria in impaired working ability and decreased social-economic values is enormous. Senator Harris, of Georgia, an able economist and former member of the Federal Trade Commission, places the economic loss to the country due to malaria at $1,000,000,000 annually. Mosquitoes, besides being the greatest known disseminators of disease, are an additional curse to humanity in the amount of annoyance and nuisance that their prevalence causes the human being. It becomes a matter of the utmost importance for the development of a region for industries or habitations that it be made virtually free of the mosquito pests. In sections of the North and East, where malaria is uncommon, it is not an unusual occurrence to hear of construction efforts handicapped and delayed by the inter-

ference of mosquitoes, or of important residential locations and pleasure resorts suffering from and being discriminated against because of the presence of these insects. As the people of this Nation progress in the demand for improved and more efficient conditions for labor and living this nuisance phase of the mosquito-control problem will call for greater and greater consideration.

In short, the prevalence of these insects in any area means that the section is unhealthy and unsuited for the dwelling of human beings, it can not be prosperous nor will it be tenanted by successful people able to move elsewhere, while those remaining will be most inefficient workers struggling vainly under grossly adverse conditions.

It is apparent therefore that mosquito control is a proposition of more significance, and is more fundamental than is commonly supposed. Its successful handling is now largely a responsibility of the engineers of the country. It is a problem that the engineer must take responsibility for, because the many activities of the engineer, such as the building of railroads, highways, impounded reservoirs, lumber mills, canals, etc., have greatly determined the extent and controllability of mosquito propagation—only too often have works as just mentioned very considerably extended and aggravated the malaria and mosquito problem. Dr. Carter once stated that for every dollar spent on roads in malarial regions of the South there has been 25 to 50 cents of harm done to public health. The control of mosquito propagation is fittingly an engineer's problem, as the sanitary engineer in his training, combining biology, physiology, and chemistry with civil engineering, is the one best qualified for the institution and development of works to combat the prevalence of the pests. The preliminary information and facts regarding the life habits of the insects and their exact relation to the spread of disease have had to be furnished by the pathologist and biologist, but to-day when it is a matter of the economical development and establishment of practical means for the control of the mosquito propagation, the problem is one very largely for the engineer.

The histories of mosquito campaigns have now firmly established the practicability and importance of the elimination of mosquitoes and the skilled technical services that are required. Cuba and Panama remain shining pioneer examples of the successful results of antimosquito works—carried on under most adverse natural conditions by which the ubiquitous stegomyia, the yellow-fever carrier, were eliminated, and the settled areas practically freed of all species of the pests. In these campaigns, engineers, who had first to be trained in this field, were placed in charge of the execution of the preventive measures. The recent Great War has produced no more emphatic lesson in sanitation than in the demonstration of the possi-

bilities of malaria-free and mosquito-free camps in the midst of malarial and marshy surroundings. The results of a thorough and continuous fight against the malarial mosquito made it possible for the Army to achieve the record in the reduction of malarial fever cases and deaths which it has—a total of 14,087 admissions and 31 deaths from malaria taking place during the war period of 1917 and 1918, which is a percentage reduction of 99.07 per cent of cases and 99.74 per cent of deaths from the rates obtaining in the Civil War, and 99.26 per cent of cases and 99.45 per cent of deaths from the rates during the Spanish American War. In the civilian zones about the military camps over 40 engineers of the Public Health Service were directing the fight against the mosquito and thousands of laborers and millions of dollars were used in providing proper drainage, oiling, and in other combative measures. Within the military zones many times this number of engineers were engaged with larger forces and bigger funds in this war against a tiny but deadly enemy of democracy and humanity.

A description of the varied measures and control works that are used by the engineers in the carrying out of antimosquito activities would be rather lengthy. I will attempt to do but little more than enumerate them here. At the very first, a survey and inspection must be made of the region to be controlled, the nature of the watercourses, geological characteristics of the locality, the places in which breeding are found or considered likely to occur and the locations where adult insects are encountered, which are all indicated on a chart plotted of the section. Usually the next step will be to study what the treatment of the different areas will be; a determination of the costs is then worked up, which will be followed by a test of one's sanitary statesmanship in obtaining the requisite financial and popular support. With the funds and authority provided, the building up of an organization of laborers, inspectors, and assistants is commenced. The problem of securing the most suitable transportation for the men and materials will generally require some earnest attention. The actual carrying out of the antimosquito work will be found to consist of two kinds—one, the constructive measures; that is, those requiring building and digging operations mostly in connection with provisions for improved drainage; and the second, the strictly control measures which will include the oiling, fish stocking, and inspection.

Of the so-named constructive measures, the principal one may be said to be the construction of proper drainage lines. These are generally planned as a system of intercepting and lateral lines of ordinary open earth ditches or canals, but provided with steeper side slopes, sometimes even to a perpendicular, and with the sharpest

obtainable invert section. Great attention must be given to the grade of these mosquito ditches in order that they may be self-scouring. In the work on tidal marshes these ditches are more strictly connecting lines and are often dug by light, self-propelled ditching machines which dig a very narrow trench a few inches in width and with perpendicular sides. In some instances, as on farms or in seepage areas within towns, open ditches, which are always more costly in upkeep, are also inadvisable even as temporary measures, and then permanent drainage by tile or lined drains is installed. In very soggy, mucky areas the construction of ditches by blowing them out with dynamite has been found most economical. In connection with the drainage operations there will usually be a vast amount of clearing and stump removal to be done from alongside stream banks and in wet areas. Added to the usually great natural obstacles, there will be frequently many man-made interferences to be overcome, such as railroad embankments, poorly planned culverts, deep borrow pits, pipe lines, log jams, etc. In some cases vertical drainage by means of shafts sunk to porous strata beneath the surface is found successful for getting rid of the water.

Again, on tidal marshes methods are employed whereby a dike shuts out the water at ordinary tidal levels and by means of tide gates the ground surface is unwatered.

In the case of bodies of impounded water, lakes, ponds, and pools, where complete drainage is usually not feasible the treatment accorded is usually the destruction of the vegetation at the water edge and on the water surface by stripping or use of subaqueous saw, by varying the water level, and then by effective control measures.

These control measures, as I have grouped them, consist of auxiliary means to prevent the propagation of mosquitoes when the body of water is not drained or carried off. This is usually accomplished by various schemes for the application of oil or larvacide to the water. Spray pumps, drip cans, oil soaked sawdust, and waste are used, and also stocking the water with top-feeding minnows. In some instances a large reservoir may be kept from breeding mosquitoes by the agitation and wave action produced by a motor boat circuiting the basin, while in other instances sewage tanks may be prevented from breeding by building tight screens and superstructures which would exclude the adult insects. Finally, the frequently overlooked breeding source in artificial containers, cisterns, catch basins, rain gutters, nondraining roofs, fire barrels, and tin cans must be watched for and treated by routinely destroying the hatching larvæ, or better still, the removal of those sources as accessible breeding grounds.

The above outline must impress one with the wide range of technical phases to the mosquito-control problem, which vary from the determination of the viscosity and toxicity of the oil to be used for preventing breeding in a fire barrel to the planning and installation of a drainage system of main canals, intercepting and lateral ditches to unwater thousands of acres of marshland.

Constructive operations on a large scale for the elimination of malarial and other mosquitoes are reported planned and partly under way in all parts of the world—in the highly malarial regions of Italy and the Balkans, in the newly reconquered lands of Palestine and Asia Minor, in Africa and South America, and even in England, where a serious renaissance of malarial epidemics is threatened due to the presence, because of the war, of numerous infected carriers.

In this country, State and local compaigns have been instituted against the malarial mosquito in nearly all of the Southern States, notably in Arkansas and Mississippi, and against the general mosquito nuisance in some eastern States, as New York, Pennsylvania, and New Jersey. New Jersey has developed extremely effective methods of combating the salt-marsh mosquitoes, and proposes to spend three-fourths of a million dollars to rid the State of its far-famed, pestiferous product. Though some work has been begun to reduce the malaria and mosquito damage in this country, it can so far scarcely be considered more than a demonstration—and usually a most successful demonstration—while much remains to be done to make a good sized commencement in the elimination of malaria and mosquito troubles.

What is imperatively needed is a program for the widespread organization of antimosquito drainage districts, fostered and stimulated by State and Federal agencies, whereby an organized permanent effort in the various localities could be made against the prevalence of the mosquito. New laws curbing the production of mosquito-breeding areas must be instituted and money grants obtained for the stimulation and assistance of this work. In the campaign for this end the engineer must take a leading part, and especially the engineers in administrative public positions. There must be found technical men who are willing to become qualified by training and study to take directing places in the undertaking of this large country-wide antimosquito work. Though perhaps this work is most times devoid of monumental evidences of the struggle and the constructive efforts frequently to be had at the completion of engineering projects, there still remains in my mind the belief that in hardly any other field of engineering activity is there work to compare with the possibilities for great service in the prevention of human suffering as in the campaign of malaria and mosquito control.

The damage and harm has been going on for countless ages; to-day we have the demonstrated means, effective and economical, for relief; only a blind humanity will ignore and refuse to make use of them.

After a discussion of the papers, the conference adjourned.

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